

# HOST ASSOCIATIONS OF BRACONID PARASITIDS (HYMENOPTERA: BRACONIDAE) REARED FROM LEPIDOPTERA FEEDING ON OAKS (*QUERCUS* SPP.) IN THE MISSOURI OZARKS<sup>1</sup>

J. B. Whitfield<sup>2</sup>, R. J. Marquis<sup>3</sup>, J. Le Corff<sup>3,4</sup>

ABSTRACT: Host/parasitoid records are provided for 32 species of braconid wasps attacking a large complex of caterpillars that feed upon five species of oaks (*Quercus* spp.) in the Missouri Ozarks. Forty of the 62 host records are new for the given species of braconids.

The faunas of both oak-feeding herbivores and their associated parasitoid communities have been found to be among the most diverse yet studied on any plant group (Opler, 1974). The forests of the Ozark Plateau are dominated by oaks and hickories, and thus are likely to harbor a large fauna of herbivores (especially caterpillars) and parasitoids. However, this region of the U. S. has been less intensively studied faunistically than many regions on the east and west coasts of North America.

From 1991 until the present, we have been intensively and quantitatively sampling the herbivore faunas of five species of oaks (white oak, *Quercus alba* L.; scarlet oak, *Q. coccinea* Muench.; northern red oak, *Q. rubra* L.; post oak, *Q. stellata* Wang.; and black oak, *Q. velutina* Lam.). These field surveys will result in the production of a field guide to the caterpillars found on these oaks in the Missouri Ozarks (Marquis et al., in press), as well as analyses of temporal and spatial variation in the herbivore (Marquis and Le Corff, 1997; Le Corff and Marquis, 1999; Marquis and Whitfield, unpublished data) and associated parasitoid (Le Corff et al., in press) communities.

The parasitoid faunas, being poorly studied in this part of the country, pose a substantial challenge in terms of species identification. The present paper focuses on those host/parasitoid records we have been able to strongly confirm within this herbivore community for braconid wasps.

## MATERIALS AND METHODS

The above-mentioned quantitative field surveys of oak herbivores were being conducted from April to September of each year. Parallel collecting efforts targeted towards trees not used in the quantitative survey (but relatively

---

<sup>1</sup> Received December 20, 1998. Accepted February 17, 1999.

<sup>2</sup> Department of Entomology, University of Arkansas, Fayetteville, AR 72701, USA.

<sup>3</sup> Department of Biology, University of Missouri-St. Louis, St. Louis, MO 62121, USA.

<sup>4</sup> Current address: Institut National d'Horticulture, 2 rue Le Nôtre, 49045 Angers Cedex 01, FRANCE.

nearby) were used to obtain caterpillars for photographic documentation, to obtain the adult stages of the herbivores to aid in identification, and to assess the identities and relative abundance of the associated parasitoids. The sites sampled (all in Missouri) were: Little Lost Creek State Forest, Daniel Boone State Forest (both near Warrenton, Montgomery Co.), Washington University's Tyson Research Center (Eureka, Jefferson Co.), Deer Run State Forest (Reynolds Co., near Ellington), Paint Rock State Forest, Cardareva State Forest, and Carr Creek State Forest (Shannon Co., near Ellington), and Peck Ranch Wildlife Reserve (Van Buren, Carter Co.). Field-collected caterpillars were brought back to the laboratory (roughly 2,000 caterpillars representing 150-200 species were collected each year) in plastic bags, sorted into individual species, then placed in 6-in diameter plastic cups with clear lids and provided with food (leaves of the tree species from which they were collected). Each caterpillar was then followed until it either died, or yielded an adult herbivore or parasitoid(s). Thus we have accurate records of the host (herbivore) insect species from which each parasitoid was reared, the oak species on which that herbivore was collected, and the locality and plot from which the sample was taken. Parasitoids from black (*Q. velutina*) and white (*Q. alba*) oaks are relatively better represented, since these two oak species were sampled for more years of the project than the other three.

After emergence, adult parasitoids were point-mounted, or placed in gelatin capsules, and labelled with respect to all relevant field collection and lab rearing data. The herbivore species were then identified by a variety of individuals listed in the Acknowledgments, while the braconid parasitoids were identified by the senior author. The following sources were especially useful in obtaining and/or confirming the braconid identifications: Marsh (1979); Muesebeck (1920, 1922, 1923, 1927, 1932, 1970); Sharkey and Janzen (1995); Shaw (1983); and Wharton et al. (1997). Host records were checked against those listed in Marsh (1979); records which then appeared to be new were subjected to computer literature searches to obtain any recent literature.

Voucher specimens of the herbivores and braconids have been deposited in the Natural History Museum, University of Missouri, St. Louis, while additional vouchers of the braconid species are in the University of Arkansas Arthropod Museum, Fayetteville.

## RESULTS AND DISCUSSION

Table 1 provides a summary of the braconid species reared, with associated host herbivore and herbivore host plant species. Readers interested in relative abundance of these parasitoids are referred to Le Corff et al. (in press).

Those braconid species that attacked microlepidoptera (esp. Gelechiidae, Oecophoridae, and Tortricidae) were niche specific. In other words, the set of hosts each of these braconid species might attack could belong to several unrelated lepidopteran families, but all would have some feeding niche (and usually

also seasonality) in common – e.g., spring-feeding leaf-rollers. Examples of this pattern were the sampled braconid species of *Bassus*, *Dolichogenidea*, *Hypomicrogaster*, *Microgaster* and *Macrocentrus* (see Table 1). Our braconid parasitoids specializing in microlepidoptera thus behaved similarly to those attacking leaf-miners in previous studies (e.g. Whitfield and Wagner, 1988, 1991, and many other studies). Braconid species specializing upon microlepidoptera ( $N = 16$ ) attacked a mean of  $2.27 \pm 1.23$  host species while only 44% of them attacked only a single host species in our study. Fifty percent of them attacked species in more than one host family (mean of  $1.71 \pm 0.79$  host families per braconid species).

In contrast, the braconid species that attacked macrolepidopteran hosts (e.g. Geometridae, Limacodidae, Noctuidae, and Notodontidae) were relatively more host-specific, attacking either a single host species or a taxonomically related set of hosts from the same genus or family (or very closely related families). Examples of this latter pattern are our records for species of *Cotesia*, *Diolcogaster*, *Protapanteles* and *Sigalphus* (see Table 1). Braconids that specialized upon macrolepidoptera ( $N = 16$ ) attacked a mean of  $1.67 \pm 1.05$  host species (except for *D. facetosa*, always from the same host family), and 69% of them attacked only a single host species.

Forty of the host/parasitoid associations provided here are new to the literature (these are marked with an asterisk in Table 1), and several of them represent newly reported (albeit not surprising) host families for their parasitoid species. In many cases, the fact that these associations have not been previously reported is not because they are actually rare in nature. Instead, it is because the caterpillar and parasitoid faunas in the Ozarks have not been previously extensively studied, and also because the parasitoids are difficult, for all but specialists, to identify. The lists we have provided are not exhaustive as several braconid species, for which we reared only one sex or only one individual, could not be identified with any confidence and were thus omitted. It is likely that most of the common species to be encountered in the Ozarks attacking oak caterpillars are represented here, given our intensive sampling over several years.

Comparisons with results of extensive malaise trap sampling of braconids from the same areas of Ozark oak-hickory forest suggest that the oak herbivores harbor approximately 30-40% of the nearly 100 braconid species that attack all caterpillars in this plant community. Thus it is likely that many of the species reported here will be reported to attack herbivores on other plant species as well.

#### ACKNOWLEDGMENTS

We thank a number of individuals for their aid in field collection and lab rearing: Sydney Cameron, Floyd Catchpole, Eric Dahms, Andy Farrell, Kathleen Gonzalez, Nancy Greig, Kathy Hayes, Cris Hochwender, Liz Jakse, Damond Kylo, Dianne Lill, John Lill, John McGrath, Kristine

**Table 1.** Identified braconid species reared from caterpillars on oak leaves in the Missouri Ozarks. Braconid species were identified by the senior author; host caterpillars were identified initially by the authors and checked by the specialists listed in the Acknowledgments. Oak species abbreviations: R- red oak (*Quercus rubrum*); B- black oak (*Q. velutina*); S - (scarlet oak, *Q. coccinea*); P- post oak (*Q. stellata*); W- white oak (*Q. alba*). \* - Host species not known to be previously recorded for the given parasitoid, although in a few cases the host genus may have been previously recorded.

Braconid species reared	Subfamily	Host species	Host family	Oaks
<i>Aleiodes</i> sp.	Rogadinae	<i>Nadata gibbosa</i> (J. E. Sm.)	Notodontidae	W
<i>Apanteles plexinus</i> Viereck	Microgastrinae	<i>Sparganothis pettitiana</i> (Rob.)	Tortricidae	B, P, R, S, W
<i>Apanteles polychrosidis</i> Viereck	Microgastrinae	* <i>Ancylys divisiana</i> (Wlk.)	Tortricidae	W, P
"	"	* <i>Argyrotaenia alisellana</i> (Rob.)	Tortricidae	W, P
"	"	* <i>Oneida lunalis</i> (Hlst.)	Pyralidae	B
<i>Ascogaster canadensis</i> Shaw	Cheloniinae	<i>Sparganothis pettitiana</i> (Rob.)	Tortricidae	B, W
<i>Bassus annulipes</i> (Cresson)	Agathidinae	* <i>Argyrotaenia quercifoliola</i> (Fitch)	Tortricidae	W
"	"	* <i>Choristoneura rosaceana</i> Harr.	Tortricidae	W
"	"	* <i>Sparganothis pettitiana</i> (Rob.)	Tortricidae	B, W
<i>Bassus calcaratus</i> (Cresson)	Agathidinae	* <i>Chionodes fuscomaculella</i> (Cham.)	Gelechiidae	W
"	Agathidinae	* <i>Psilocorsis quercicella</i> Clem.	Oecophoridae	P, W
"	"	* <i>Psilocorsis reflexella</i> (Pack.)	Oecophoridae	W
<i>Bassus cinctus</i> (Cresson)	Agathidinae	* <i>Sparganothis pettitiana</i> (Rob.)	Tortricidae	W
"	"	<i>Dichomeris liquellula</i> (Hbn.)	Tortricidae	B
"	"	* <i>Pseudotelphusa</i> sp.	Gelechiidae	P, W
<i>Cotesia prob. acromyctae</i> (Riley)	Microgastrinae	<i>Acronycta haesiata</i> (Grt.)	Noctuidae	W
<i>Cotesia diacrisiae</i> (Gahan)	Microgastrinae	* <i>Dasychira obliquata</i> (G. & R.)	Lymantriidae	B
"	"	* <i>Dasychira tephra</i> Hbn.	Lymantriidae	W
<i>Cotesia empretiae</i> (Viereck)	Microgastrinae	* <i>Apoda biguttata</i> (Pack.)	Limacodidae	S
"	"	<i>Euclia delphimiti</i> (Bdv.)	Limacodidae	W
"	"	<i>Parasa indetermina</i> (Bdv.)	Limacodidae	W
<i>Cotesia flavicornis</i> (Riley)	Microgastrinae	* <i>Erynnis juvenalis</i> (Fab.)	Hesperiidae	B
<i>Cotesia hyphantriae</i> (Riley)	Microgastrinae	* <i>Morrisonia confusa</i> (Hbn.)	Noctuidae	B, P, R, S, W
<i>Cotesia phobeae</i> (Rohwer)	Microgastrinae	<i>Halysidota tessellaris</i> (J. E. Sm.)	Arctidae	B
<i>Deuterixys</i> sp. (probably undescribed)	Microgastrinae	<i>Bucculatrix</i> sp.	Bucculatricidae	W
<i>Diolcogaster facetosa</i> (Weed)	Microgastrinae	* <i>Catocala amica</i> (Hbn.)	Noctuidae	W
"	"	* <i>Lochmaeus manto</i> (Doubleday)	Notodontidae	B, W





Mothershead, Evan Notman, Kirk Stowe, Philip Weyman, Rick Whitney, and Eric Wold. The following provided or confirmed host caterpillar identifications that we could not complete ourselves: Ronald W. Hodges (especially Gelechioidea), Steve and Valerie Passoa (many groups), Jerry Powell (Tortricicoidea), and David Wagner (leafminers).

Funding for our field work was provided by the Missouri Department of Conservation, and for production of the caterpillar field guide, which lead to many of the identifications, by the Missouri Department of Conservation and the U. S. Forest Service.

#### LITERATURE CITED

- Le Corff, J. and R. J. Marquis.** 1999. Differences between canopy and understorey in herbivore community composition and leaf quality for two oak species in Missouri. *Ecol. Entomol.* 24: 46-58.
- Le Corff, J., R. J. Marquis and J. B. Whitfield.** In press. Temporal and spatial variation in the parasitoid community associated with the herbivores that feed on Missouri *Quercus*. *Environ. Entomol.*
- Marquis, R. J. and J. Le Corff.** 1997. Estimating pretreatment variation on the oak leaf chewing insect fauna of the Missouri Ozark Forest Ecosystem Project (MOFEP). Pp. 332-346 in: Brookshire, B. L. and S. R. Shifley, eds., Proceedings of the Missouri Ozark Forest Ecosystem Project, Gen. Tech. Rep. NC-193, USDA For. Serv., N. Cent. Exp. Sta., St. Paul, MN.
- Marquis, R. J., S. Passoa, J. Whitfield, J. Le Corff and V. Passoa.** In press. An Illustrated Field Guide to the Immature Lepidopteran Fauna of Missouri Oaks. U. S. D. A. Forest Service Technology Transfer Program.
- Marsh, P. M.** 1979. Family Braconidae, pp. 144-295 in: Krombein, K. V., P. D. Hurd, D. R. Smith and B. D. Burks, eds., Catalog of Hymenoptera in America North of Mexico. Smithsonian. Inst. Press, Washington, D. C.
- Muesebeck, C. F. W.** 1920. A revision of the North American ichneumon-flies belonging to the genus *Apanteles*. *Proc. U. S. Nat. Mus.* 58: 483-576.
- Muesebeck, C. F. W.** 1922. A revision of the North American ichneumon-flies belonging to the subfamilies Neoneurinae and Microgasterinae. *Proc. U. S. Nat. Mus.* 61: 1-76.
- Muesebeck, C. F. W.** 1923. A revision of the North American species of ichneumon-flies belonging to the genus *Meteorus* Haliday. *Proc. U. S. Nat. Mus.* 63: 1-44.
- Muesebeck, C. F. W.** 1927. A revision of the parasitic wasps of the subfamily Braconinae occurring in America north of Mexico. *Proc. U. S. Nat. Mus.* 69: 1-73.
- Muesebeck, C. F. W.** 1932. Revision of the Nearctic ichneumon-flies belonging to the genus *Macrocentrus*. *Proc. U. S. Nat. Mus.* 80: 1-55.
- Muesebeck, C. F. W.** 1970. The nearctic species of *Orgilus* Haliday (Hymenoptera: Braconidae). *Smithson. Contrib. Zool.* 30: 1-104.
- Opler, P. A.** 1974. Biology, ecology and host specificity of microlepidoptera associated with *Quercus agrifolia* (Fagaceae). *Univ. Calif. Publ. Entomol.* 75: 1-83.
- Sharkey, M. J. and D. H. Janzen.** 1995. Review of the world species of *Sigalphus* (Hymenoptera: Braconidae: Sigalphinae) and biology of *Sigalphus romeroi*, new species. *J. Hymenop. Res.* 4: 99-109.
- Shaw, S. R.** 1983. A taxonomic study of nearctic *Ascogaster* and a description of a new genus *Leptodrepana* (Hymenoptera: Braconidae). *Entomography* 2: 1-54.
- Wharton, R. A., P. M. Marsh and M. J. Sharkey,** eds. 1997. Manual of the New World Genera of the Family Braconidae (Hymenoptera). *Int. Soc. Hymenop. Spec. Publ.* No. 1.
- Whitfield, J. B. and D. L. Wagner.** 1988. Patterns in host ranges within the nearctic species of the parasitoid genus *Pholetesor* Mason (Hymenoptera: Braconidae). *Environ. Entomol.* 17: 608-615.
- Whitfield, J. B. and D. L. Wagner.** 1991. Annotated key to the genera of Braconidae (Hymenoptera) attacking leafmining Lepidoptera in the Holarctic Region. *J. Nat. Hist.* 25: 733-754.